

# Low Impact Development

Presented by  
Art Castle  
([acastle@kitsaphba.com](mailto:acastle@kitsaphba.com))  
Home Builders Association of Kitsap County  
February, 2005

## Kitsap Home Builder Foundation Grant Application

- Develop Low Impact Development Standards Implementation for Kitsap County, Bremerton, Bainbridge Island, Port Orchard and Poulsbo
- Enable developers, builders, homeowners and jurisdiction to have the option of using low impact development techniques to manage stormwater

## Kitsap Home Builder Foundation Grant Application

- L I D Education
  - Development and Construction Industry
  - County and City staff who review development and construction approval processes.
  - Public
- Develop Design Manual “How to” for industry and jurisdictions.

## Kitsap Home Builder Foundation Grant Application

- \$182,550 from EPA “319” Clean Water funding through DOE with 25% HBA match
- Ranked 23 of 109 applications
- Grant for starting end of 2005 and completing in 2008. Goal is to start fall 2005 and have ordinances adopted by end of 2006

## Kitsap Home Builder Foundation Grant Application

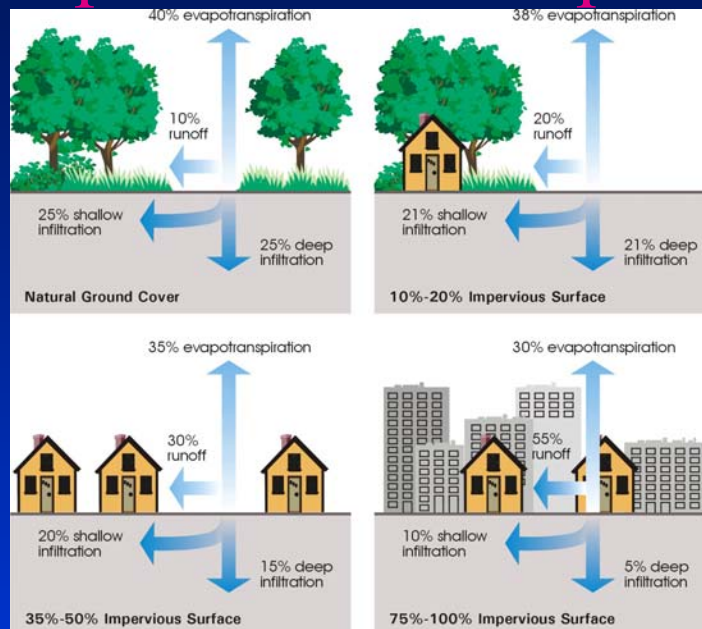
- Partners include
  - Bremerton, Poulsbo, Port Orchard, Bainbridge Island, Kitsap County
  - Kitsap Health District
  - Suquamish Tribe
  - Citizens for Responsible Planning
- Industry Leading with Market-Based Environmental Solutions as with our Build A Better Kitsap/BUILT GREEN program

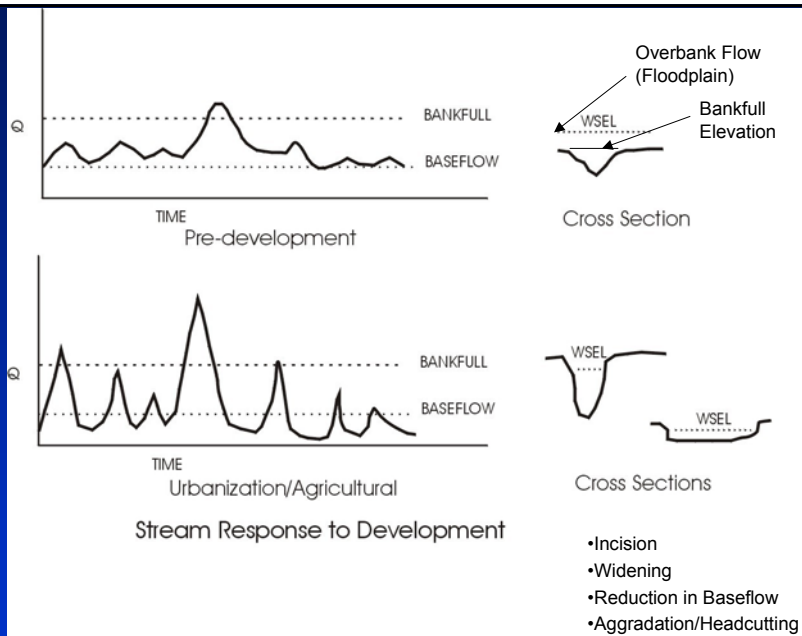
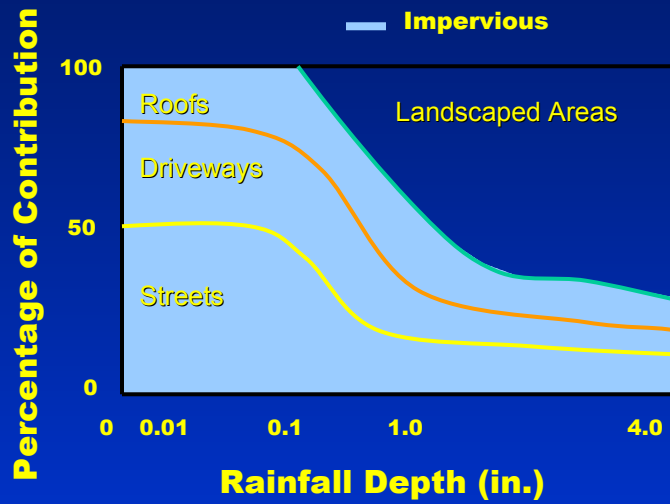
# What is Low Impact Development?

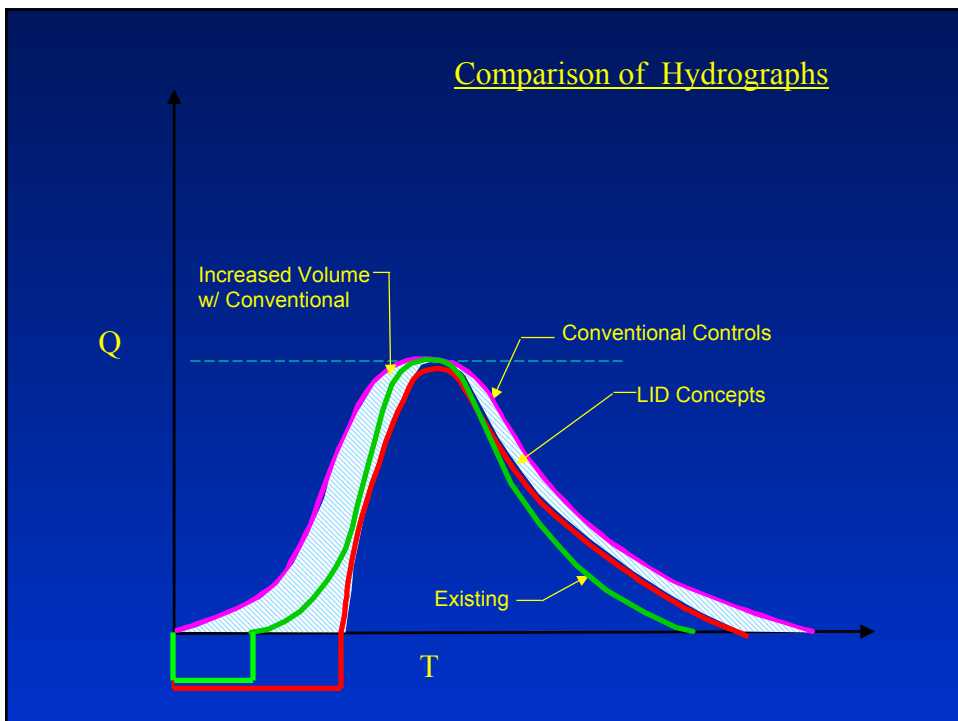
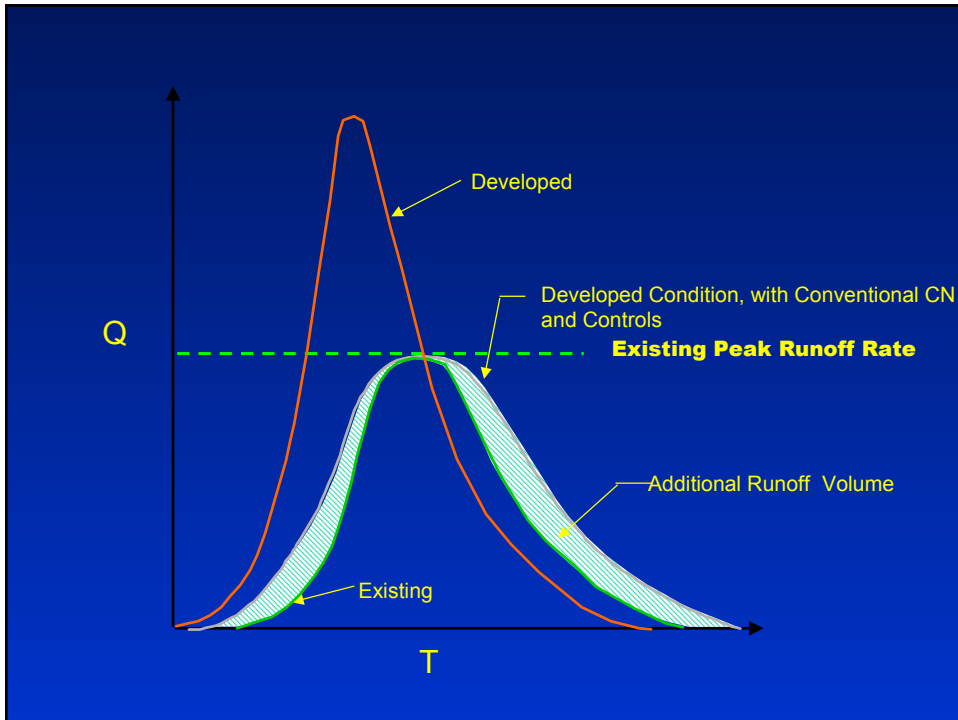
# Low-Impact Development (LID)

- A sustainable stormwater management strategy that combines precision engineering with micro-scale controls that are engineered, designed and integrated into site features in order to maintain, restore or closely mimic pre-development watershed hydrologic functions (volume, recharge, evaporation and runoff).
- Reduces development and maintenance costs and promotes public participation/education in pollution prevention and maintenance of LID practices.

## Impacts of Development







Low Impact Development  
“Designing for Nature”

Micro-scale Management

“Think Small”



***LID IS NOT:***

- Conservation Design
- New Urbanism
- Restricted Impervious Percentage

***LID IS:***

***A Multi-functional “customized” approach to stormwater management and environmental protection that can be integrated into any site design philosophy.***

**“UNIVERSAL APPLICATIONS”**

## *Why Low Impact Development Was Conceived*

- Improve Stormwater Technology BMP's
  - New Tools and Principles
- Reduce Stormwater Infrastructure Costs
- Reduce Development Costs
- Meet New Regulatory Requirements
- Resource Protection
- Urban Retrofit





*The Problem: Conventional Site Design*

*Efficient*

*Collect*

*Concentrate*

*Convey*

*Central Treatment*

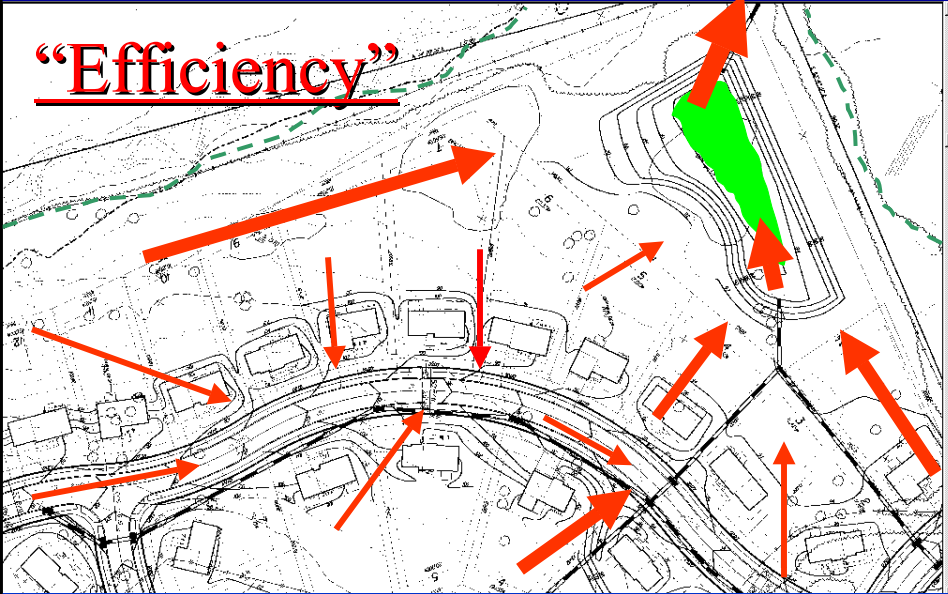


*Roadways, Paved Surfaces and Turf Used to  
Collect and Convey Runoff*



## Conventional Pipe and Pond Centralized Control

**“Efficiency”**



## LID Uniform Distribution of Micro Controls



# Conventional vs. Low-Impact Development

## Conventional

- “End-of-the-Pipe” Control
- Maintaining Peak Discharge Only
- Very Limited Control on Small Storms
- “Stuck in the 60’s”

## Low-Impact

- Source Control
- Mimic Pre-Development Hydrologic Conditions
- Full Control on Small Storms
- Pollution Prevention

# Why LID Works

- Cumulative Impacts (Think Small)
- On-Site Treatment
- Uniform Distribution (Mimics)
- Promotes Resources Conservation
- Economically Sustainable (Small Scale )
- Public Participation / Education
  - Responsibility (Property Owner)
  - Vested Interest in Property Values

# LID Benefits

- Restores Hydrologic Functions
- Economically Sustainable
  - Efficient Use of Space / Reduced Infrastructure
  - Property Value
  - Scale of Maintenance Burdens
  - Reduces Development Costs
- Multi-Objective
- Integrated Capitalization
- New Tools for Urban Retrofit
- Practical / Simple / Universally Applicable
- Efficient Pollutant Removal

## Construction Cost Comparison

	<u>Patuxent Riding</u>	
	<u>Conventional</u>	<u>Low Impact</u>
<u>Grading /Roads</u>	\$ 569,698	\$ 426,575
<u>StormDrains</u>	\$ 225,721	\$ 132,558
<u>Stormwater Fees</u>	\$ 260,858	\$ 10,530
<u>Bioretention / Micro</u>	\$ -	\$ 252,124
<u>Total</u>	\$ 1,086,277	\$ 821,787
<u>Unit Cost</u>	\$ 14,679	\$ 10,146
<u>Lot Yield</u>	74	81

## LID COSTS

- Cost Savings
  - No or Smaller Ponds
  - Less Piping
  - Fewer Structures
  - Less Curb / Gutters
  - Less Paving
  - Less Grading
  - Maintenance
  - Energy Conservation
- Cost increases
  - Design
  - Grading
  - Site Investigation
  - Landscaping
  - Maintenance

## Pollution Removal by Depth in Bioretention Facilities

		Removal (%)						
		Cu ( $\mu$ g/L)	Pb ( $\mu$ g/L)	Zn ( $\mu$ g/L)	P (mg/L)	TKN (mg/L)	NH <sub>4</sub> <sup>+</sup> (mg/L)	NO <sub>3</sub> <sup>-</sup> (mg/L)
Large Box	Upper	90	93	87	0	37	54	(-97)
	Middle	93	>97	>96	73	60	86	(-194)
	Lower	93	>97	>96	81	68	79	23
Field		97 $\pm$ 2	>95	>95	65 $\pm$ 8	52 $\pm$ 7	92 $\pm$ 7	16 $\pm$ 6

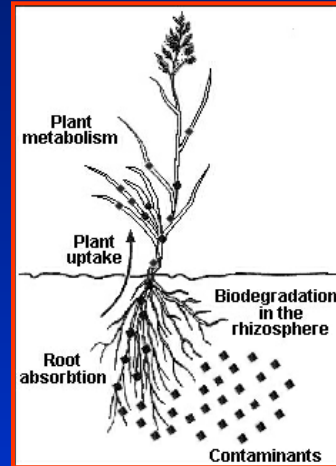
# Biological Pollutant Removal

## Plant / Soil Flora / Soil Chemistry

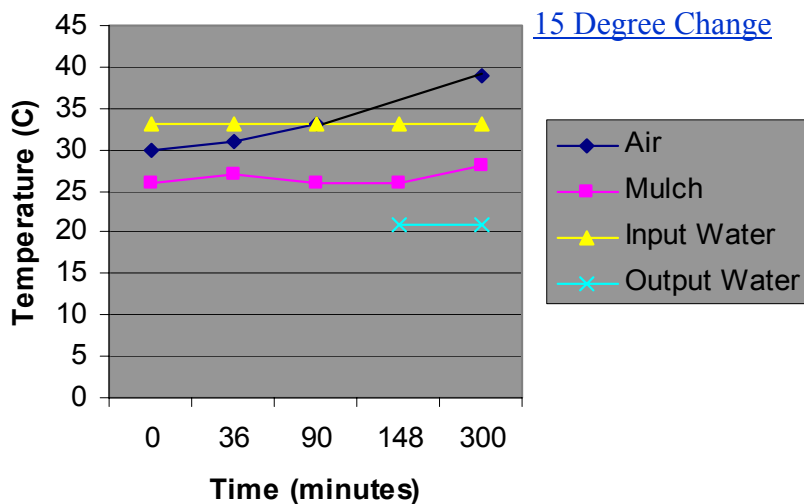
- **Phytoremediation**

- Translocate
- Accumulate
- Metabolize
- Volatilize
- Detoxify
- Degrade
  - Exudates

- **Bioremediation**



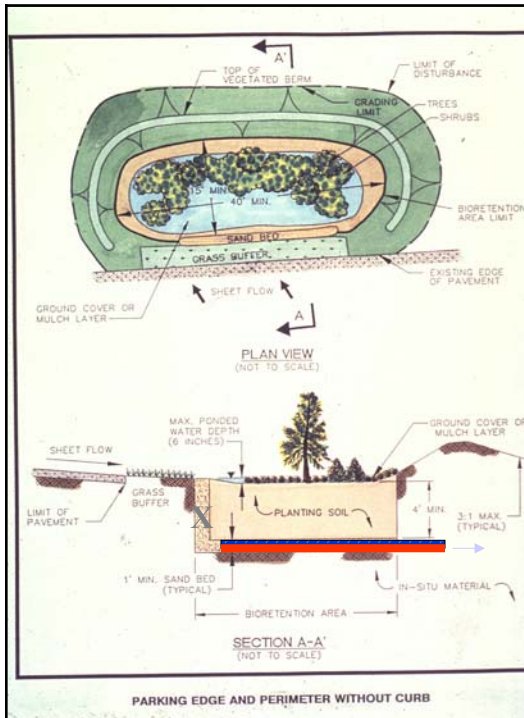
**Bioretention Temperature Data**



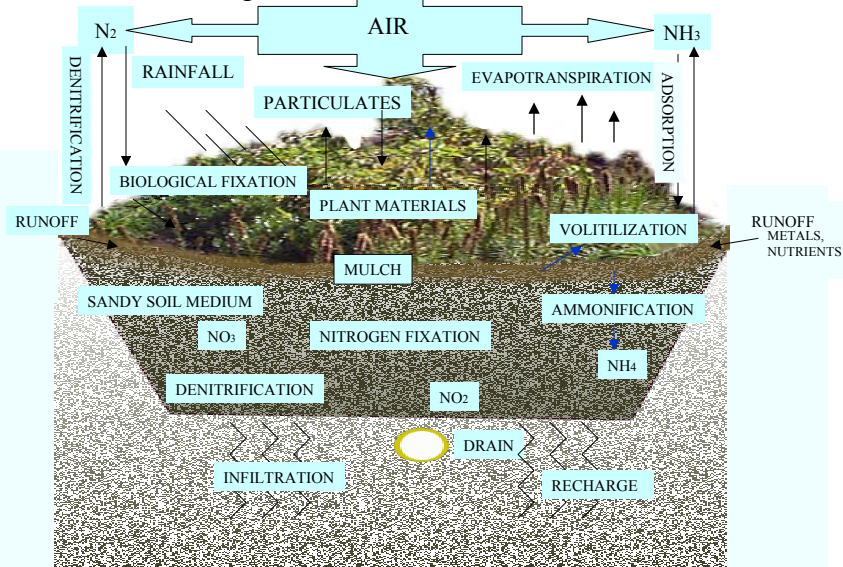
Dr. Davis Inglewood Study- 6/9/99

# Bioretention

- Shallow Ponding
- Infiltration and/or Filtration
- Volume Control
- Multifunctional Landscape
- Aesthetic Value
- Habitat Value
- Property Value
- Low Cost Maintenance
- High Pollutant Removal



## Plant / Soil Complex



## NITROGEN CYCLE FOR BIORETENTION



# LID Practices (No Limit!)

## *“Creative Techniques to Use, Store, Detain and Recharge”*

- Bioretention / Rain Gardens
- Strategic Grading
- Site Finger Printing
- Resource Conservation
- Flatter Wider Detention Swales
- Flatter Slopes
- Long Flow Paths
- Tree / Shrub Depression
- Turf Depression
- Landscape Islands Storage
- Rooftop Detention /Retention
- Roof Leader Disconnection
- Parking Lot / Street Storage
- Smaller Culverts, Pipes & Inlets
- Alternative Surfaces
- Reduce Impervious Surface
- Surface Roughness Technology
- Rain Barrels / Cisterns / Water Use
- Catch Basins / Seepage Pits
- Sidewalk Storage
- Vegetative Swales, Buffers & Strips
- Infiltration Swales & Trenches
- Eliminate Curb and Gutter
- Shoulder Vegetation
- Maximize Sheet flow
- Maintain Drainage Patterns
- Reforestation
- Pollution Prevention.....

## LID Design Procedure Highlights

- Site Analysis
- Determine Design Storm
- Maintain Flow Patterns and Tc
- Conservation and Prevention
- Develop LID CN
- Compensatory Techniques. Stress Volume Control then Detention or Hybrid for Peak







**Runoff Use  
Consumption  
Reduction  
Save \$100 / yr.**



**Tree Conservation  
Rain Gardens  
Open Drainage**





Multifunctional  
Swales

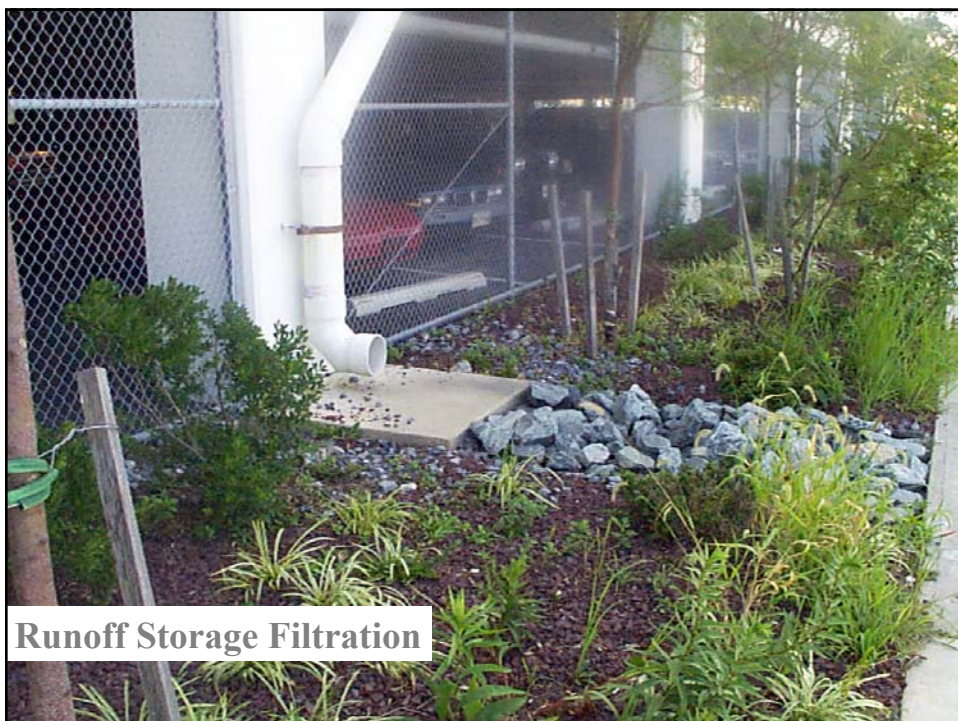
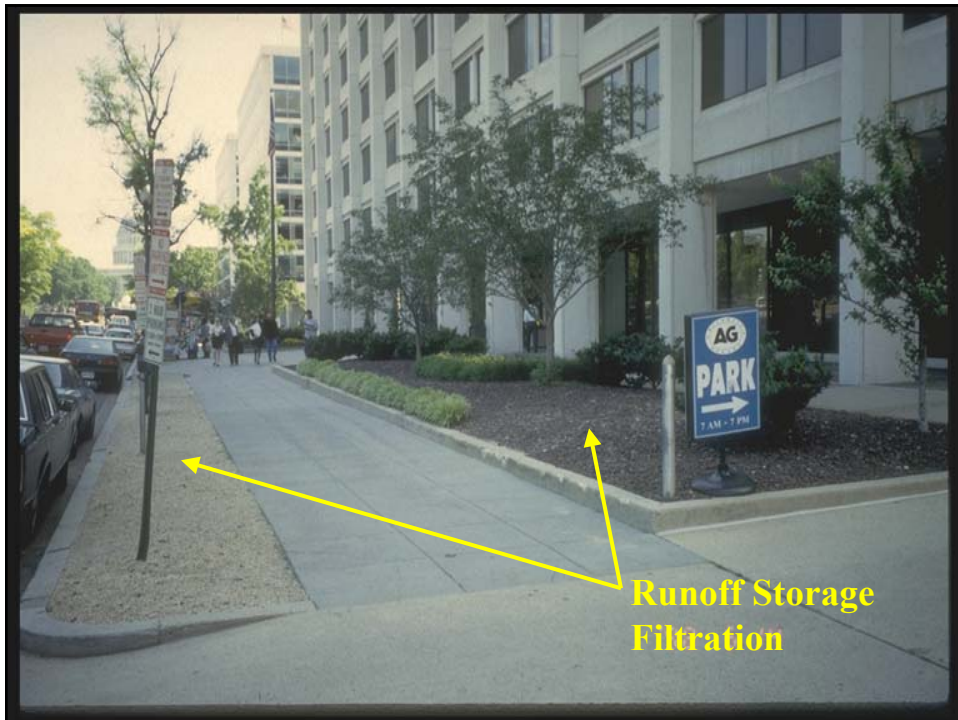














The urban landscape can provide multiple environmental functions and serve typical urban needs!









## Bioretention Landscaping



High Flow Rate Filter and Infiltration  
Treats 90% of Total Annual Volume